$$\therefore\ p=\{\pi^2/[2r(\tfrac{4}{3}\pi r^3)^2]\}\int_0^{2r} x(3r-x)(2r-x)dx\int_{2r-x}^{2r}[y/(3r-x)][r^2-(3r-x-y)^2]dy$$

$$=(3/128r^7)\int_0^{2r}(14rx^5-x^6-48r^2x^4+48r^3x^3)dx=(3/128r^7)(1664r^7/105)=\tfrac{13}{35}.$$

$$2.\ \Delta=\{\pi^2/[2r(\tfrac{4}{3}\pi r^3)^2]\}\int_0^{2r} x(3r-x)(2r-x)dx\int_{2r-x}^{4r-x}[y^2/(3r-x)][r^2-(3r-x-y)^2]dy$$

$$=(3/40r^4)\int_0^{2r}(92r^3x-106r^2x^2+40rx^3-5x^4)dx=(3/40r^4)(88r^5/3)=11r/5.$$

80. Proposed by G. B. M. ZERR, A. M., Ph. D., Professor of Mathematics and Science, Chester High School, Chester, Pa.

A box contains 100 balls marked from 1 to 100. 13 balls are drawn at random. What is the chance that the balls marked from 1 to 10 are included in the 13 drawn?

Solution by J. W. YOUNG, Columbus, Ohio.

Since in all the favorable chances only three balls may vary, the total number of favorable chances is ${}^{90}C_3$, *i. e.*, the number of combinations of 90 things taken 3 at a time.

The total number of ways in which the balls may be drawn is, of course, ${}^{100}C_{13}$.

Hence the desired probability is equal to

$$\frac{{}^{90}C_3}{{}^{100}C_{13}}=\frac{\dfrac{90.89.88}{1.2.3}}{\dfrac{100.99.98.97.96.....89.88}{1.2.3.5.....13}}=\frac{1}{67515927540}.$$

PROBLEMS FOR SOLUTION.

ARITHMETIC.

124. Proposed by ALOIS F. KOVARIK, Instructor in Mathematics and Science, Decorah Institute, Decorah, Iowa.

At what time between 5 and 6 o'clock is the minute hand midway between 12 and the hour hand? When is the hour hand midway between 4 and the minute hand?

125. Proposed by F. M. PRIEST, Mona House, St. Louis, Mo.

A Quaker once, we understand
For his three sons laid off his land,
And made three equal circles meet
So as to bound an acre neat.
Now in the center of the acre,
Was found the dwelling of the Quaker;
In centers of the circles round,
A dwelling for each son was found.
Now can you tell by skill or art
How many rods they live ap:

*** Solutions of these problems should be sent to B. F. Finkel not later than March 10.

ALGEBRA.

115. Proposed by ALOIS F. KOVARIK, Instructor in Mathematics and Science, Decorah Institute, Decorah, Iowa.

Find the conditions of the coefficients of a general biquadratic equation so that it may be solved by quadratics.

116. Proposed by ARTEMAS MARTIN, A. M., Ph. D., LL. D., U. S. Coast and Geodetic Survey Office, Washington, D. C.

Solve the equations:

$$w(xy+xz+yz)=a;\ x(wy+wz+yz)=b;$$
$$y(wx+wz+xz)=c;\ z(wx+wy+xy)=d.$$

*** Solutions of these problems should be sent to J. M. Colaw not later than March 10.

GEOMETRY.

135. Proposed by WILLIAM HOOVER, A. M., Ph. D., Professor of Mathematics and Astronomy, Ohio University, Athens, O.

If a hyperbola be described touching the four sides of a quadrilateral which is inscribed in a circle, and one focus lie on the circle, the other focus will also lie on the circle.

136. Proposed by J. OWEN MAHONEY, B. E., M. Sc., Professor of Mathematics, Central High School, Dallas, Tex.

Construct a triangle having given the base, the median line to the base, and the difference of the base angles.

137. Proposed by J. W. YOUNG, Fellow and Assistant, Ohio State University, Columbus, O.

A right cone has its vertex in a horizontal plane, its axis being perpendicular to the plane. A string has one extremity attached to a point on the cone. The other extremity, P, of the string is kept in the plane, and the string is then wound around the cone, without being allowed to slip. Show that the spiral generated by P cuts all straight lines through the vertex at the same angle.

*** Solutions of these problems should be sent to B. F. Finkel not later than March 10.

CALCULUS.

106. Proposed by M. C. STEVENS, M. A., Professor of Mathematics, Purdue University, Lafayette, Ind.

$$\int_0^{\pi} \frac{\cos rx\,dx}{1-2a\cos x+a^2} = \frac{\pi r^2}{1-a^2}.$$

[*Williamson's Integral Calculus*, 6th Edition, page 174.]